USER MANUAL

BSD-016

SINGLE-AXIS DRIVER
FOR BIPOLAR AND UNIPOLAR STEP MOTORS

INTERINAR ELECTRONICS, LLC.
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1 HARDWARE REFERENCE

1.1.1 OVERVIEW

The BSD-016 drives Unipolar and Bipolar Step Motors converting Step and Direction signals from the external microcontroller to amplified phase currents. Any source of TTL level signals (5V logic) can be used as a controlling device for BSD-016 driver. The operation with CMOS 3.3V external devices is possible but not guaranteed. However, we can deliver a special CMOS 3.3V version if requested.

1.2 HARDWARE DESCRIPTION

The BSD-016 is based on powerful DMOS microstepping circuit with internal translator.
The simplicity of the design has advantage in lower number of components making this driver a very rigid and reliable. Once configured correctly the driver does not require any further adjustments or maintenance.
Single voltage supply simplifies power requirements and lowers overall system cost.

1.2.1 DRIVER FEATURES

- Bipolar operation
- Built-in translator
- Phase Current from 95mA to 1500mA (default)
- Phase Current from 12mA to 185mA (special order)
- Four Stepping Modes: Full, Half, $1/4^{th}$, $1/8^{th}$ (BSD-016-8) or $1/16^{th}$ (BSD-016-16)
- Automatic current decay mode detection/selection
- Mixed and Slow current decay modes
- Synchronous rectification for low power dissipation
- Fixed Off-Time current regulator for Constant Current operation
- Internal Under-Voltage-Lock-Out protection
- Thermal Shutdown protection
- Crossover Current protection
- Single Power Supply
- Automatic Idle Current Reduction (ICR)

1.3 CONNECTORS

1.3.1 AVAILABLE CONNECTORS

The BSD-016 features following connectors:

- **POWER CONNECTOR (J1)** – power for step motor and circuits on board
- **MOTOR CONNECTOR (J3)** – step motor
- **SIGNAL INPUT CONNECTOR (J4) –** Enable, Step and Direction signals

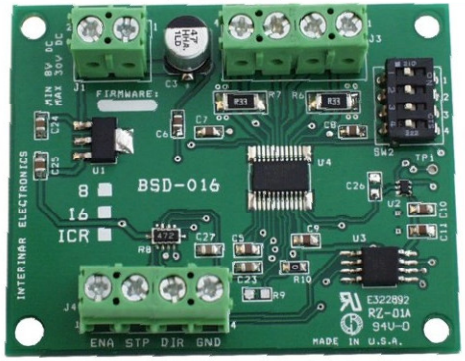


Figure 1. BSD-016

1.3.2 POWER CONNECTOR – J1

Connector type: Standard 5mm, 2-pole terminal block, acceptable wires size 26 to 12 AWG.

Table 1 – POWER CONNECTOR – J1

Terminal #	PIN DESCRIPTION	LABEL
1	Negative or Common Voltage Supply	GND
2	Positive Voltage Supply	+VB

Polarity reversal is **NOT ALLOWED** and will cause permanent damage to the driver.
Exceeding Max Allowed Voltage will result in permanent damage to the driver.

When using a non-stabilized power supply, specifically rectifier/capacitor type, please derate the Supply Voltage to 70% in order to prevent overvoltage and damage to the driver. This type of power supply can produce about 1.4 times the rated voltage when the load is not present or very low. This type of overvoltage condition may occur when the driver is disabled.

1.3.3 MOTOR CONNECTOR – J3

Connector type: Standard 5mm, 4-pole terminal block, acceptable wires size 26 to 12 AWG.

Two pairs of terminals belonging to the same phase are located next to each other and labeled on the board as PH1 and PH2.
Mixing wires of two phases together is prohibited and may result in permanent damage to the driver.

In case the initial rotation of the motor needs to be reversed and the DIR input cannot be used, swap the wires of just one phase. Do not swap the wires of both phases at the same time, as this will not reverse the direction.

Table 2 – MOTOR CONNECTOR – J3

Terminal #	PIN DESCRIPTION	LABEL
1	OUT2B	PH2
2	OUT2A	
3	OUT1A	PH1
4	OUT1B	

1.3.4 SIGNAL INPUT CONNECTOR – J4

Connector type: Standard 5mm, 4-pole terminal block, acceptable wires size 26 to 12 AWG.

This connector is used for signals from external microcontroller or PC.
All three inputs feature 4.7kohm internal pull-up resistors to +5V. This way controlling the input is as simple as shorting it to the Ground. Any sinking device may be used for that purpose.
Specifically, this can be done with jumper, switch, open-collector, open-drain, direct TTL gate output. In all other cases, it is important to make sure there will be no voltage exceeding +5V or lower than -0.3V present on any input at any time.

Table 3 – SIGNAL INPUT CONNECTOR – J4

Terminal #	PIN DESCRIPTION	LABEL
1	Enable	ENA
2	Step	STP
3	Direction	DIR
4	Ground	GND

1.3.4.1 ENA – Enable.

Input – active LOW.
Internally pulled up to +5V trough 4.7kohm resistor.
When LOW, all motor outputs are ENABLED.
When HIGH, all motor outputs are DISABLED, but translator is still processing Step and Direction signals. This condition may result in initial position error when using ENABLE to start and stop the motor. The driver must be ENABLED in advance before Step and Direction changes.
Regardless of operation mode, the driver stops powering the motor, when ENABLE signal is HIGH, absent or not connected.

1.3.4.2 STP - Step.

Input – active LOW.
Internally pulled up to +5V trough 4.7kohm resistor.
A Low-to-High transition (rising edge) advances the motor one increment. The size of the increment is determined by MS1 and MS2 (*see Table 5*). Minimum Step pulse High Time (width) is 1.0us. Minimum Step pulse Low Time is 1.0us.

1.3.4.3 DIR - Direction.

Input – active LOW.
Internally pulled up to +5V trough 4.7kohm resistor.
Sets the direction of rotation.
Any changes to this input do not take effect until the next Step rising edge.
If the motor connections follow correct phase order, then when this input is Low, the direction will be Clockwise and when High, Counterclockwise. Swapping wires of just one phase will also reverse direction.

1.3.4.4 GND - Ground.

Signal Ground – return path for all three inputs.
Should not be used as power ground.

1.3.5 SW2 DIP-SWITCH

The 4-position dip-switch is used in process of setting motor parameters and configuring the driver. Each individual switch is numbered from 1 to 4. The driver is shipped with all switches in OFF state as default.

Table 4 – Power-Up Mode Condition Truth Table

MODE	SW2.x				MODE DESCRIPTION
	.1	.2	.3	.4	
S1	**ON**	OFF	OFF	OFF	SETUP – $V_{REF(MAX)}$ (Max Motor Current)
S2	**ON**	**ON**	OFF	OFF	SETUP – Idle $V_{REF(ICR)}$ (Idle Motor Current)
N1	OFF	OFF	OFF	OFF	NORMAL OPERATION no ICR
N2	OFF	**ON**	OFF	OFF	NORMAL OPERATION with ICR

1.3.5.1 SW2.1 – Motor Current Setup.

Default: OFF
Allowed position during boot up: ON, OFF
Allowed position in normal operation: **OFF**
Used in modes: S1, S2.
Function during boot up: see Table 4.

1.3.5.2 SW2.2 – Idle Motor Current Setup or Normal Operation with ICR.

Default: OFF
Allowed position during boot up: ON, OFF
Allowed position in normal operation: **ON, OFF**
Used in modes: S2, N2.
Function during boot up: see Table 4.

1.3.5.3 SW2.3 – Microstepping MS1.

Default: OFF
Allowed position during boot up: ON or OFF
Allowed position in normal operation: ON or OFF
Used in modes: N1, N2.
Function during boot up: has no effect.
Function during normal operation: see Table 5.

1.3.5.4 SW2.4 – Microstepping MS2.

Default: OFF
Allowed position during boot up: ON or OFF
Allowed position in normal operation: ON or OFF
Used in modes: N1, N2.
Function during boot up: has no effect.
Function during normal operation: see Table 5.

Table 5 – Microstepping Resolution Truth Table

SW2.3 (MS1)	SW2.4 (MS2)	RESOLUTION–STEP		EXCITATION MODE	
		BSD-016-8	BSD-016-16	BSD-016-8	BSD-016-16
ON	**ON**	FULL	FULL	2 PHASE	2 PHASE
OFF	**ON**	HALF	HALF	1-2 PHASE	1-2 PHASE
ON	OFF	QUARTER	QUARTER	W1-2 PHASE	W1-2 PHASE
OFF	OFF	EIGHTH	SIXTEENTH	2W1-2 PHASE	4W1-2 PHASE

1.4 CONNECTING TO BSD-016

1.4.1 POWER SUPPLY

The power supply selection should be based on step motor specification and maximum allowable voltage for the driver. There is no need for stabilized power supply, however it is recommended to use it.
When using a non-stabilized power supply, specifically rectifier/capacitor type, please derate the Max Allowed Voltage to 70% in order to prevent overvoltage and damage to the driver. This type of power supply can produce about 1.4 times the rated voltage when the load is not present or very low. This type of overvoltage condition may occur when the driver is disabled.

NEVER CONNECT OR DISCONNECT ANY WIRE FROM BSD-016 WHILE POWER IN ON.

1.4.2 STEP MOTOR.

The step motor should be connected to the J3 terminal block. Labels are placed next to the terminals in two groups, clearly marking each phase. There is no reference to the beginning or the end of each phase.
Make sure that all four motor wires are tightly connected and there is no possibility of accidental disconnection. For 6- and 8-wire motors, all unused wires must be insulated separately. This is especially important when additional connectors are used between the driver and the motor.

DISCONNECTING MOTOR WHILE POWER IS ON WILL CAUSE PERMANENT DAMAGE TO THE DRIVER.

1.4.3 EXTERNAL CONTROLLER

BSD-016 requires external Step, Direction and Enable signals connected to terminal block J4. The fourth pole is used for signal ground and should not be used as power ground. All three inputs are pulled-up internally to +5V through 4.7kohm resistors. The TTL (5V level) interface, open-collector, opto-coupler, relay and switch can be used directly in connection with this port (see Figure 2). The CMOS 3.3V operation is possible but not guaranteed.
If not used, the Direction input may be left disconnected.
The Enable input, if not used, may be permanently shorted to GND if the driver works in N2 mode with IRC and the Idle current is set low. Living Enable shorted for prolonged time with current set high may lead to motor and driver overheating.

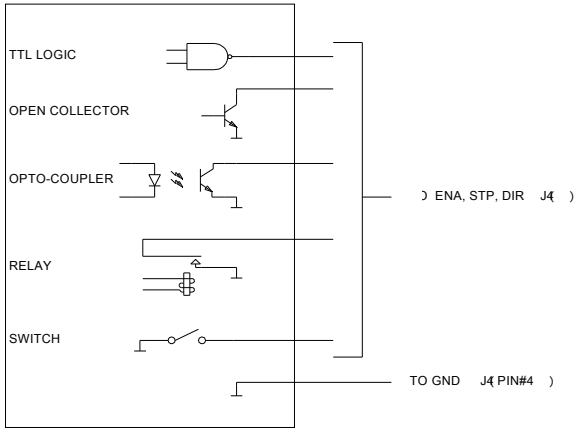


Figure 2. Typical Input Driving Methods.

2 OPERATION MODES

2.1.1 OVERVIEW

Prior to normal operation the BSD-016 requires a simple setup. Possible modes are listed below.

- Setup Mode
  - **S1** – Max Motor Current Setup
  - **S2** – Idle Motor Current Setup for ICR
- Normal Mode
  - **N1** – Normal Operation without ICR
  - **N2** – Normal Operation with ICR

Regardless of operation mode, the BSD-016 always stops powering the motor when ENABLE signal is HIGH, absent or not connected.

2.2 SETUP MODE

In Setup mode, the BSD-016 will set and store:
- Max Motor Current
- Idle Motor Current

2.2.1 S1 – MAX MOTOR CURRENT SETUP MODE

The max phase current must be set first. The phase current can be obtained directly from the label of the motor, data sheet or manufacturer. The BSD-016 is a CONSTANT CURRENT driver. The phase current is all you need to know to setup the driver.
To adjust and keep the phase current at correct level the BSD-016 uses reference voltage $V_{REF,}$ always present on TP1 (Test Point located right below dip-switch SW2). The relation between $\mathbf{V_{REF}}$ and max phase current $\mathbf{I_{MAX}}$ can be described as follows:

$$\mathbf{V_{REF(MAX)}\ [V] = k\ x\ I_{MAX}\ [A]}$$

Where:
- $V_{REF(MAX)}$ in Volts
- I_{MAX} in Amperes
- k – coefficient, based on value of the sensing resistors R6, R7
  k=2.64 for 0.33ohm resistors marked as R33 for standard version 95mA to 1500mA
  k=21.6 for 2.7ohm resistors marked as 2R7 for special version 12mA to 185mA

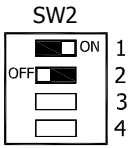
Example:
- Motor is labeled 0.91A, BSD-016 driver with 0.33ohm sensing resistors

$$V_{REF(MAX)} = 2.64 \times 0.91A = 2.4V$$

This $V_{REF(MAX)}$ value must be used during motor current setup procedure.

The S1 mode can be entered only during boot up (power up) process, while the SW2.1 dip-switch is in ON and SW2.2 is in OFF position (see Table 4).

Enter mode S1:
- Turn OFF the power
- Turn ON switch SW2.1
- Turn OFF switch SW2.2
- Switches SW2.3 and SW2.4 are irrelevant in this mode



S1

- Connect Volt Meter between TP1 and GND
- Turn ON the power
- Observe, as the V_{REF} will rise slowly from 0V towards 4.0V.
- When V_{REF} reaches calculated value slide the SW2.1 switch back to OFF position
- If you missed the right moment, then let the voltage go up. Once it reaches 4.0V, it will reset to 0V and start rising up again.
- If you switched it OFF at wrong value, then you have to turn OFF the power and repeat the entire process.

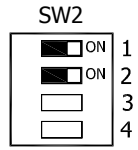
Exit from mode S1:
- Move SW2.1 to OFF position
- Turn OFF the power

Actual storing of the V_{REF} value to the EEPROM occurs while the SW2.1 moves from the ON to the OFF position. However, storing can be performed only once per each cycle. That means, in case of mistake, the whole procedure must be repeated, starting from turning OFF the power and then reentering the S1 mode again.
The driver will not function correctly until the next power OFF to ON transition.

2.2.2 S2 - IDLE MOTOR CURRENT SETUP MODE

This setup must be performed only, if user intends to use BSD-016 with ICR (Automatic Idle Current Reduction). Calculation for $V_{REF(ICR)}$ is the same as for $V_{REF(MAX)}$.
The S2 mode can be entered only during boot up (power up) process while the SW2.1 and SW2.2 dip-switches are ON (see table 4).

Enter mode S2:
- Turn OFF the power
- Turn ON switches SW2.1 and SW2.2
- Switches SW2.3 and SW2.4 are irrelevant for this mode



S2

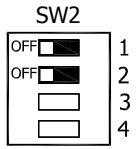
- Connect Volt Meter between TP1 and GND
- Turn ON the power
- Observe, as the V_{REF} will rise slowly from 0V towards $V_{REF(MAX)}$ value set in S1 mode.
- When V_{REF} reaches calculated value slide the SW2.1 switch back to OFF position
- If you missed the right moment, then let the voltage go up. Once it reaches $V_{REF(MAX)}$, it will reset to 0V and start rising up again.
- If you switched it OFF at wrong value, then you have to turn OFF the power and repeat the entire process.

Exit mode S2:
- Move SW2.1 to OFF position
- Turn OFF the power

Actual storing of the V_{REF} value to the EEPROM occurs while the SW2.1 moves from the ON to the OFF position. However, storing can be performed only once per each cycle. That means, in case of mistake, the whole procedure must be repeated, starting from turning OFF the power and then reentering the S2 mode again.
The driver will not function correctly until the next power OFF to ON transition.

2.3 NORMAL MODE

The BSD-016 will function properly only in Normal Mode N1 or N2.
To access N1 the SW2.1 and SW2.2 must be in OFF position and after power up the driver will enter Normal Mode N1 based on stored parameters.
To access N2, the SW2.1 should be OFF and SW2.2 ON. The position of the SW2.3 and SW2.4 is irrelevant.



N1

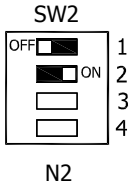
2.3.1 N1 – NORMAL OPERATION WITHOUT ICR

The BSD-016 energizes the motor only when ENABLE signal is low. Motor will start rotate when the STEP pulse is present on STP input. The direction of the rotation depends on signal level present on DIR input.
Parameters necessary for N1 Operation Mode:
- Perform S1 setup
- Cycle the power OFF/ON

2.3.2 N2 – NORMAL OPERATION WITH ICR.

The BSD-016 energizes the motor only when ENABLE signal is low. Motor will start rotate when the STEP pulse is present on STP input. The direction of the rotation depends on signal level present on DIR input. If the STEP pulse is absent for period longer than 2 seconds, the driver will enter ICR mode and lower the phase current to the level set during S2 setup.
Parameters necessary for N2 Operation Mode:

- Perform S1 setup
- Perform S2 setup
- Set SW2.1 OFF and SW2.2 ON
- Cycle the power OFF/ON



2.4 AUTOMATIC IDLE CURRENT REDUCTION (ICR)

The BSD-016 driver is equipped with Automatic Idle Current Reduction (ICR) circuitry. The main purpose of using this feature is the reduction of the heat dissipated in the motor and driver during the time when the motor stays idle in one position (without moving), for prolonged time. Driving the motor at 100% its rated current while still standing will not only produce the heat in the motor, which may lead to overheating, but it is a waste of energy. In majority of applications, the torque needed to hold the load in the position is minimal compared to the torque needed to move the load from one position to another. Only a handful of applications require producing the holding torque at the same level during both rotation and stand still periods.

Automatic Idle Current Reduction is available in N2 mode. It is activated 2 seconds after the last change on the STP input. When turned ON it will lower V_{REF} from $V_{REF(MAX)}$ to $V_{REF(ICR)}$.
The V_{REF} is restored to $V_{REF(MAX)}$ within 700us after arrival of the next step pulse on STP input.

The Idle Current may be set to any value in range from 0 to 100% of the I_{MAX}.
In other words, you may adjust $V_{REF(ICR)}$ to any value in range from 0 to 100% of the $V_{REF(MAX)}$.

Automatic Idle Current Reduction IS NOT AVAILABLE IN SETUP MODES S1 or S2.

3 APPLICATION

3.1 POWER SUPPLY

The BSD-016 is a Constant-Current driver, which means that it will maintain the phase current regardless of the voltage applied to the driver. However, this statement implies certain limitations described below.

3.1.1 VOLTAGE

The BSD-016 works most of the time in Constant-Current Mode by switching the voltage on motor terminals (chopping), while monitoring and maintaining the level of the phase current. The driver will stay in Constant-Current Mode as long as the voltage applied to the power terminal is higher than the rated voltage of the motor. For example, motor label shows 12V. The BSD-016 will work in Constant-Current Mode only if the power supply voltage is above 12V and lower than max allowed for the driver 30V. If the power supply delivers 12V or less, the driver will work in Voltage Mode. In such case, the driver will no longer maintain the phase-current, which will be limited directly by the resistance of the motor's windings.
Both regulated and unregulated power supplies may be used.
A regulated power supply can be rated up to max allowed voltage for the BSD-016 which is 30Vdc. However, unregulated power supply cannot exceed 21Vdc because it is rated at full load current. At lesser loads, like when the driver is disabled, the actual voltage of the power supply may be up to 1.4 times higher, which will exceed the maximum voltage allowed for the driver.

3.1.2 CURRENT

The BSD-016 requires no more current than the twice of the phase-current (2 x I_{ph}) of the motor.
There is a common misconception, based on wrong measurements, that in real application only fraction of that current is being utilized. However, these measurements are performed using RMS values, which lead to mistakes in selecting the power supply. If the power supply is not capable of supplying enough current, then the driver will not be able to deliver it to the motor. As a result, the motor will not produce the torque specified in data sheet.
The current needed for logic on the board is marginal and may be ignored in this calculation.

3.2 STEPPER MOTOR

The BSD-016 is based on DMOS technology and despite the fact that it features output protection it will be damaged if not properly connected to the motor. Common mistakes include phase wire mixing and connecting motor directly to VB or Gnd.
Only two-phase stepper motors may be used. That includes both bipolar and unipolar motors. Bipolar motors are always 4-wire type. Unipolar motors come in 6- or 8-wire version, which gives additional flexibility in selecting performance.
Most of "thin-can" 2-phase motors have different switching sequence and will not work with BSD-016 (please compare switching sequence in motor data sheet).
The 5-phase motors cannot be used with BSD-016.

NEVER CONNECT OR DISCONNECT THE MOTOR WHILE THE POWER IS ON.
INSULATE UNUSED MOTOR LEADS SEPARATELY.
DO NOT CONNECT ANY MOTOR LEADS TO GROUND OR POWER SUPPLY.

3.2.1 4-WIRE MOTORS

This type of motor can be connected only one way. See drawing below. Swapping two wires of just one phase will cause motor to rotate in opposite direction.

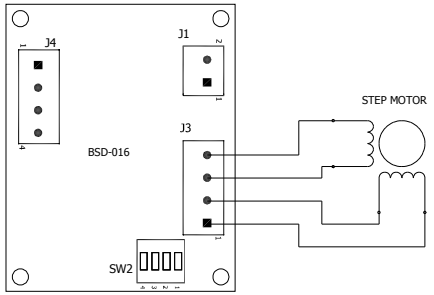


Figure 3. Bipolar 4-wire motor connection.

Table 6 – Parameters for bipolar 4-wire motor.

MODE	POWER	CURRENT	VOLTAGE	TORQUE
Bipolar	100%	100%	100%	100%

3.2.2 6-WIRE MOTORS

Motors with 6 leads can be connected in two different ways:
1. Bipolar-Series connection- center tap is not used. Both ends of each phase are connected to the driver. In series connection, motor should be operated at 70% of the rated current. Running motor at full rated current will saturate and overheat the motor. The series connection is preferred method because it produces less heat in the driver and produces higher torque.

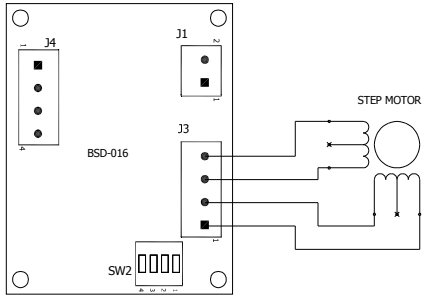


Figure 4. Bipolar-series connection of 6-wire motor.

The BSD-016 may not be able to drive some motors in series connection. Specifically, construction of 7.5 degree tin-can motors requires different switching sequence. In such case, center tap connection must be used.
Unipolar connection – one end of each phase is insulated. The other end and center tap are connected to the driver. The driver should be adjusted to full rated current of the motor. This connection works better at higher speeds.

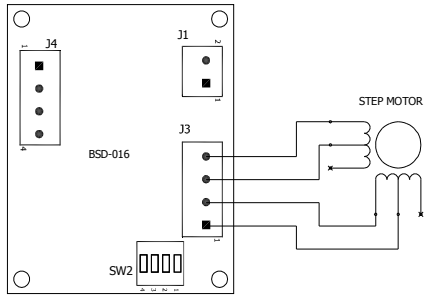


Figure 5. Unipolar connection of 6-wire motor.

Table 7 – Parameters for 6-wire motor

MODE	POWER	CURRENT	VOLTAGE	TORQUE
Bipolar-Series	100%	70%	140%	140%
Unipolar	100%	100%	100%	100%

3.2.3 8-WIRE MOTORS

This motor can be connected in three ways.
1. Bipolar-Series connection. Gives more torque at lower speeds. In series connection, motor should be operated at only 70% of the rated current because using twice as large winding of each phase produces rated torque at lower current. Running motor at full rated current will saturate and overheat the motor.

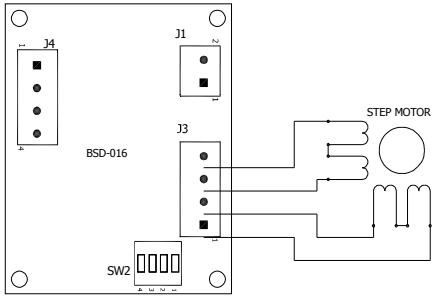


Figure 6. Bipolar-series connection of 8-wire motor.

Unipolar connection – only one pair of each phase is used. This connection works better at higher speeds.

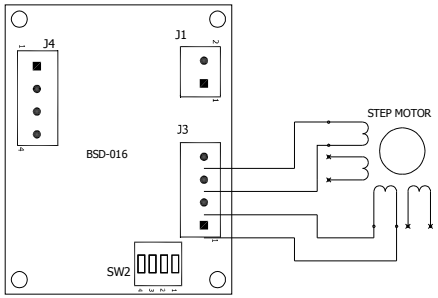


Figure 7. Unipolar connection of 8-wire motor.

Bipolar-Parallel connection. Motor should be run at 1.4 of the rated current. This connection is not recommended as higher current generates more heat in the driver and motor.

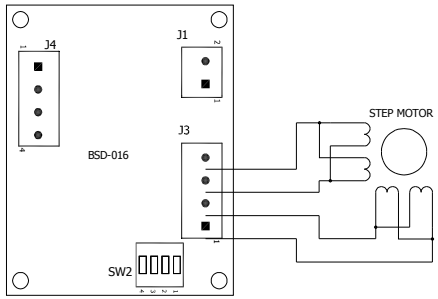


Figure 8. Bipolar-parallel connection of 8-wire motor.

Table 8 – Parameters for 8-wire motor.

MODE	POWER	CURRENT	VOLTAGE	TORQUE
Bipolar-Series	100%	70%	140%	140%
Bipolar-Parallel	100%	140%	70%	140%
Unipolar	100%	100%	100%	100%

4 ELECTRICAL AND MECHANICAL SPECIFICATION

4.1 ABSOLUTE MAXIMUM RATINGS

Table 9 – Absolute maximum ratings for BSD-016 driver-controller.

CHARACTERISTIC	SYMBOL	RATING	UNITS
Supply Voltage	VB	30	V
Motor Current	I_{OUT}	+/- 1.5	A
Logic Input Voltage	V_{IN}	-0.3 to +5.5	V
Operating Ambient Temperature	Ta	-20 to 85	°C

4.2 ELECTRICAL CHARACTERISTICS

Table 10 – Electrical characteristics for BSD-016 driver-controller.

CHARACTERISTIC	SYMBOL	Condition	Min	Typ	Max	UNITS
Motor Outputs						
Motor Supply Voltage	VB	Operating	8		30	V
Motor Current	I_{OUT}	Standard	95		1500	mA
		Special	12		185	mA
Control Logic – Enable, Step, Direction, STA						
Logic Input Voltage	V_{IH} (1)		3.5	-	-	V
	V_{IL} (0)		-	-	1.5	V
Control Analog Input – ANA						
Analog DC Voltage	V_{ANA}		0	-	5	V
Protection						
Crossover Dead Time	t_{DT}		100	475	800	ns
Thermal Shutdown Temperature	Tj		-	165	-	°C
Thermal Shutdown Hysteresis	Tj_{HYS}		-	15	-	°C
Automatic Idle Current Reduction (ICR)						
ICR ON delay time after last Step pulse	t_{ICRon}		-	2	-	s
ICR OFF delay time after first Step pulse	t_{ICRoff}		-	-	700	us
Idle current reduction in % of I_{MAX}	I_{ICR}		0	-	100	%

4.3 EXTERNAL STEP PULSE TIMING PARAMETERS ON STP INPUT

Table 11 – Step pulse timing parameters.

CHARACTERISTIC	SYMBOL	TYP	UNITS
STEP – Minimum HIGH pulse width	t_A	1	µs
STEP – Minimum LOW pulse width	t_B	1	µs
Setup time	t_C	200	ns
Hold time	t_D	200	ns
Maximum frequency	f_{STP}	500	kHz

4.4 SAFETY SUMMARY

Always remove power and discharge the circuit before touching it.
This module contains parts susceptible to damage by ESD (Electrostatic Discharge). The BSD-016 must be handled in accordance to procedures specified for ESD devices.
Do not make any modification to the board or components.
DO NOT PLUG/UNPLUG ANY WIRES AND CONNECTORS TO/FROM THE MODULE WHILE POWER IS ON.

4.5 TROUBLESHOOTING

If driver does not function according to previously set mode, turn it off and make sure that the SW2.1 is in OFF position. Turn ON the power again and observe presence of +5V (min 4.5V, max 5.2V) on C25. If min of +4.5V is not present, then contact our Technical Support by sending email to support@interinar.com

4.6 TECHNICAL SUPPORT

Interinar Electronics is happy to respond to any question or concern regarding the BSD-016 or any other product it manufactures or sells. Contact Technical Support Staff by sending email to support@interinar.com

5 DIMENSIONS AND MOUNTING

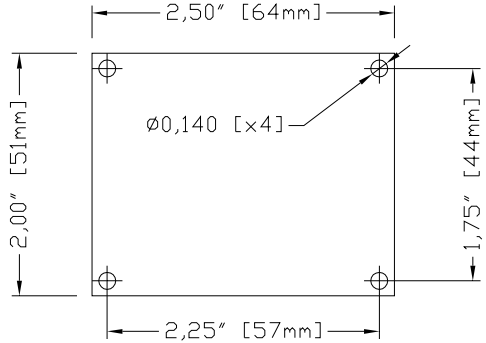


Figure 9. Mechanical dimensions.

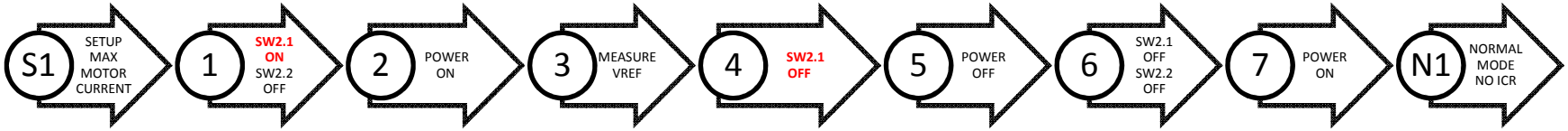
BSD-016 QUICK SETUP GUIDE

First, decide in which mode the driver should work:

- **N1** – Normal Operation no ICR - driver without Idle Current Reduction
- **N2** – Normal Operation with ICR - driver with Idle Current Reduction

Second, perform setup necessary for selected mode.

N1 SETUP FOR DRIVER – NO ICR



N2 SETUP FOR DRIVER – WITH ICR